# Financial Returns of Pharmaceutical American Depository Receipts (ADRs): Do They Perform Better than U.S. Pharmaceuticals or S&P 500?

Review of Integrative Business & Economics Research

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**ABSTRACT**

Prior research on the performance of American Depository Receipts (ADRs) from the market timing perspective mainly measured cumulative excess returns in 21-day or 3-year windows. These studies did not investigate ADRs performance from a risk-free perspective or their performances within a specific industry. Filling this gap of knowledge, this research introduces the concept and measurement of risk-free returns of ADRs in 17 years (2000 to 2016) within the healthcare industry. For risk-free measurement, we use the Sharpe ratios in which a 91-day US Treasury bill is a proxy of a risk-free rate. We chose pharmaceutical ADRs and compared their returns with U.S. pharmaceuticals and S&P 500 Index. Our non-parametric tests of Sharpe Ratios suggested that the distribution of Sharpe Ratios of ADRs, U.S pharmaceuticals, and S&P 500 have the same medians. These findings have nuanced differences from prior research. Our findings have managerial implications.

Keywords: American Depository Receipts, pharmaceutical companies, Sharpe Ratio, Non-Parametric Hypothesis Test.

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## 1. INTRODUCTION

All industries are global. Healthcare industry is of no exception. While surgeons in the U.S. may not routinely operate on a patient in India, the advancement of Information and Communication Technologies (ICT) has made Tele-surgeries a reality. In fact, surgeons or robots do perform remote tele-surgeries and together they will have a dramatic impact on the healthcare industry worldwide. No doubt, healthcare has definitely gone global. Medical tourism is another example in the global healthcare industry. In addition to remote tele- or robotic-surgeries and medical tourism, pharmaceutical products have been global products for quite a long time. In fact, in the U.S. in 2015, 25% of pharmaceutical products were imported from abroad, mainly from Ireland, Germany, Switzerland, Israel, and India, amounting to a US$85 billion dollar business (ITA, 2016).

For foreign pharmaceutical companies, the U.S. is not only a large market place for their products, U.S. is a major market to raise capital. Issuing American Depository


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Receipts (ADRs) on U.S. bourses to access the capital market in the U.S. is one example. Access to a large capital market to raise substantial fund is in particularly important to pharmaceutical and bio-tech companies as the upfront costs of Research and Development (R&D) are notoriously risky and high (Espinosa, Gietzmann and Raonic, 2009). Issuing ADRs in the U.S. requires foreign firms to be US GAAP complaint. Sometimes US institutional investors would accept disclosure of non-financial performance indicators as a partial substitute for a more stringent US financial reporting standards (Espinosa, et al., 2009). In other words, there is some nuanced difference in the disclosure information between ADRs and local U.S. stocks and thus may suggest different risks between the two investment products.

From the investors' perspective, ADRs is one way to diversify a portfolio (Arnold, Nail, and Nixon, 2004; Schaub, 2012). Another motivation to invest in ADRs is the possibility of higher returns than domestic stocks or stock indices (e.g., Elliot and Schaub, 2009; Schaub, 2012). However, mixed results were reported with ADRs both out-perform and under-perform when compared to S&P 500 or NASDAQ depending on the investment time period, and developed versus developing markets. Furthermore, prior research have not considered the risk-free perspective of investing in ADRs. In other words, unlike measuring risk-free portfolio of equities is a widely accepted practice (Sharpe 1966; Sharpe, 1994; Sharpe, 2007), research in ADRs have yet to measure risk-free returns. To fill this gap of knowledge, we propose to use the a 91-day US Treasury bill as a proxy of a risk-free rate to calculate the Sharpe ratios of pharmaceutical ADRs and compare their returns to US pharmaceuticals and S&P 500 Index. Our approach thus differs from prior research that mainly used cumulative excess returns of ADRs. Previous research focus on markets (e.g., Brazil, China, U.S. European), our research focuses on an industry – pharmaceuticals. Prior works with the focus of market timing strategies measured performance within the time period of 21-days to three years (e.g., Schaub 2013; Schaub, 2016). Our data spans from 2000 to 2016, a total of 17 years. Another difference of our paper is instead of using parametric test assuming normal distribution of returns in prior work, we use a non-parametric test as the stock returns are found to be not normally distributed.

In the remaining of the paper, we begin with a brief review of relevant literature, followed by the details of Sharpe ratio measurement. Analysis of data from New York Stock Exchange (NYSE) of eleven pharmaceutical ADRs and top 5 U.S. pharmaceutical stocks listed on the same Exchange, coupled with 91 day Treasury note and S&P 500 will be presented. We conclude with discussions and managerial implications.

## 2. LITERATURE REVIEW

Research in the performance of ADRs mainly viewed the decision to invest in ADRs and its subsequent returns as a market timing strategy (e.g., Schaub and Highfield 2006; Schaub 2007; Schaub 2010). In other words, researchers were interested in the returns of an ADR within a certain period of time from the first day of its listing. The most common time window for these enquiries were 21-days or 3 years from the first day of its listing in either NASDAQ (e.g., Schaub and Lacewell 2016) or NYSE (e.g., Schaub and Rao 2005). The results mainly focused on whether ADRs overperform or underperform when compared to a stock Index such as NASDAQ or S&P 500.


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Researchers sometimes split their dataset to investigate whether the ADRs stemmed from developing or developed countries (e.g., Schaub, 2016). Some investigated ADRs from one foreign country such as China (Schaub, 2010) or Brazil (Elliot and Schaub 2009), or multiple countries (e.g., 36 countries in Schaub and Highfield, 2004). Based on these various approaches that prior research chose to investigate ADRs and their performance, we organize the literature in terms of overperform/underperform, developed/developing countries, time window of 21-days or 3 years, and the Indices ADRs performance are compared against. Table 1 lists the literature organized according to these various approaches.

Aligning with the motivation to invest in ADRs because of their superior returns when compared against non-ADRs in the U.S. stock market, researchers found support of ADRs overperformance when compared to S&P 500 index (Elliot and Schaub, 2009; Schaub 2005; Schaub and Highfield, 2004; Schaub and Highfield, 2006; Schaub, 2010, 2012, 2013, 2015) or NASDAQ Index (Schaub, 2006; Schaub, 2009; Schaub, 2016). Overperformance was reported in the range from approximately 3% to 51%. On the other hand, researchers also found ADRs underperformed when compared to S&P 500 Index (Schaub, 2006, 2010, 2013, 2015; Schaub and Highfield, 2004, 2016; Schaub and Rao, 2005), or NASDAQ Index (Schaub, 2007). Underperformacne was reported in the range from approximately 1% to 15%.

From the literature, most of the reported overperformance of ADRs were from emerging economies. Researchers consistently found ADRs from emerging markets overperformed when compared to S&P 500 Index (Elliot and Schaub, 2009; Schaub, 2010, 2012, 2015; Schaub and Rao, 2005; Schaub and Highfield, 2006) or NASDAQ Index (Schaub, 2009, 2016). A smaller portion of research findings reported ADRs from developed markets overperform when compared to S&P 500 Index (Schaub, 2004, 2012, 2015) or NASDAQ Index (Schaub, 2007, 2016). However reports for underperformance also appeared for ADRs from both developed markets (Schaub, 2007; Schaub 2013; Schaub 2015; Schaub and Rao 2005) and developing markets (Schaub 2007, 2010, 2015; Schaub and Highfield, 2006) when compared to S&P 500 or NASDAQ Index.

The performance of ADRs in various markets, developed or developing, also vary depending on which timeframe the returns were being calculated. In the longitudinal lens, researchers used the demarcation of before and after a certain year (e.g., 1998 was the year chosen for Schaub, 2006, 2007, 2010; Schaub and Highfield, 2004, 2006), or use a decade as a broader stroke describing a timeline (e.g., 1990s versus 2000s used in Schaub, 2012; Schaub, 2015). Schaub and colleagues reported mixed results with some studies found ADRs underperformance in the pre-1998 timeframe (Schaub, 2007, 2010; Schaub and Highfield, 2004, 2006) and some in the post-1998 timeframe (Schaub, 2006). For overperformance, they were mainly found in the post-1998 timeframe (Schaub, 2007, 2010; Schaub and Highfield, 2004). The results for the decade demarcation were mixed with some found 1990s to be overperformance (Schaub, 2012, 2015) and 2000s (Schaub, 2013, 2015) for others.


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Table 1: Samples of Literature on the comparisons of ADRs performance with major stock indices

| Authors | Over-perform | Under-perform | Developed markets | Developing markets | Timeline | Short-long-term | Stock Exchange |
|---|---|---|---|---|---|---|---|
| Schaub and Highfield (2004) | x | | x | x total 36 countries | <1998 >1998 | 21 days | S&P 500 |
| Schaub and Rao (2005) | x (developing) 3% | x (developed) .93% | x | x | 1987-2001 | 2 weeks | S&P 500 |
| Schaub 2006 | | X (developing) | | x | 1985-2001 | 3 years | NASDAQ |
| Schaub (2007) | x | x <1998,15% | x | x | <1998 >1998 | 3 years | NASDAQ |
| Schaub (2009) | | | | | | | NASDAQ |
| Elliott and Schaub (2009) | | | | x Brazil | | | S&P 500 |
| Schaub (2010) | | X | | X China | <1998 >1998 | 3 years | S&P 500 |
| Schaub (2012) | X (developing in 2000s) | X (developed in 1990s) | x | x | | 21 days | S&P 500 |
| Schaub (2013) | X (developed in 2000s 19%) | X (developed in 1990s) | x | | 1990s | 3 years | S&P 500 |
| Schaub (2015) | X (European in 2000s, LatAm in 1990s) | X (LatAm in 2000s, Europe in 1990s) | X Europe | X LatAm | 1990s 2000s | 3 years | S&P 500 |
| Schaub (2016) | X (21-day small firms from developed; 3 year from developing) | | x | x | | 21 days 3 years | NASDAQ |

Another time dimension that moderates underperformance or overperformance of ADRs is the time from the first day of the listing of ADRs. Researchers viewed this as a surrogate measurement of market timing effect, using 21 days as a short-term measurement and 3 years as a long term measurement. Almost all short-term (21 days) measurements overperformed Studies that reported short-term overperformance of ADRs include Schaub and Highfield (2014) which found ADRs from 36 countries issued after June 1, 1998 overperformed the S&P 500 index. Elliot and Schaub (2009) reported that the Brazilian ADRs overperformed the S&P 500 index in 21-day measurement. Schaub (2012) showed that ADRs from emerging market overperformed in their short-term cumulative excess returns in the 2000s when compared to S&P 500 Index in 2000s, but ADRs from developed market only overperformed in the short-term in the 1990s but not in the 2000s. Recently Schaub (2016) reported that the cumulative short-term excess return of ADRs of small firms from developed countries listed in NASDAQ Exchange overperformed when compared to NASDAQ Index. The only 21-day returns that reported as underperformance was by Schaub and Highfield (2004) which showed that the cumulative average excess returns of ADRs from 36 countries issued prior to June 1, 1998 underperformed when compared to the S&P 500 Index.

In the longer-term measurement (i.e., 3 years), there are more reports of underperformance than overperformance when compared to either S&P 500 Index or NASDAQ Index. Schaub and Highfield (2006) found that ADRs from emerging


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markets that were issued before 1998 showed negative 3-year excess cumulative excess returns when compared to S&P 500 index. Contrarily, ADRs from developing markets that were issued after 1998 in NASDAQ underperformed in their 3-year returns when compared to the NASDAQ Index (Schaub, 2016). Worse for ADRs listed in NASDAQ prior to 1998, their 3-year returns were found to underperform NASDAQ Index by 15% (Schaub, 2007). Also for ADRs from medium-sized firms in China that were listed prior to 1998, their 3-year performance were below that of S&P 500 Index (Schaub, 2010). Long-term returns of ADRs issued in the 1990s from European and developed countries were found to underperform S&P 500 Index (Schaub, 2013, 2015), and the same was true for ADRs issued by Latin American companies in the 2000s (Schaub, 2015). For the longer term 3-year returns, there are some overperformance. Namely, for emerging markets when compared to S&P 500 (e.g., from Brazil in Eliot and Schaub, 2009; Schaub, 2016; Schaub and Highfield, 2004), before 1998 for both developed and developing markets when compared to NASDAQ (Schaub, 2007), for ADRs from developed countries (Schaub, 2013), and ADRs from developing countries (Schaub, 2016).

## 3. METHOD

The method used in previous studies by Schaub and colleagues was to measure excess return of an individual ADR that was calculated by subtracting the return of the S&P 500 index from the return of the individual equity. The average daily excess return of all ADRs was evaluated as the arithmetic average of the excess returns of all ADRs. For example, Schaub and Highfield (2004) summed up the daily average excess returns of all ADRs for twenty-one days and calculated the cumulative average excess returns of all ADRs, and treated it as a single entity. In their approach, they did not show the annual financial return of any individual ADR. In other words, as they pool the ADRs and reported them in aggregate, it is not clear whether the overall performance was dominated by a few selective ADRs. Furthermore in some cases (Schaub, 2010,2016), medium-sized or small firms were used which were not congruent with most of the firm sizes in S&P 500. While the approach used by Schaub and colleagues have merit in addressing market timing strategy, we find three additional approaches that may add to the existing body of knowledge in the literature. One, as many equity portfolio managers have used a risk-free approach to evaluate their investments (Sharpe, 2007), we feel that investigating ADRs from a risk-free perspective have value. For this we introduce the Sharpe ratio and uses the 91-day US Treasury Bill as a risk-free rate (Habib and Stracca, 2015). Second, although 3-year has been viewed as a long-term window for market timing strategy, we believe there are situations that portfolio managers will buy-and-hold ADRs longer than 3 years. To address this, we propose to measure ADRs returns for more than 10 years. Third, prior research has not attempted to address industry-specific ADRs. We find that in practice, portfolio managers do invest in specific industries. Therefore, there is added value to investigate industry-


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specific performance of ADRs. We chose healthcare industry, pharmaceuticals in particular. In the following we will introduce Sharpe Ratio and its measurements.

Sharpe (1966, 1994, and 2007) developed a measure for the risk-free portfolio performance, which is now widely used to determine the performances of equities. The Sharpe ratio for an ADR, $SR_a$ is defined as:

> $SR_a$ = (Average annual return of the ADR –RFR)/(Standard Deviation in the return of the ADR)
>
> RFR refers to Risk-Free Rate, which is the average annual return on 91-day US Treasury bill. We obtained these rates from St Louis Federal Reserve Bank web site: https://fred.stlouisfed.org/

The Sharpe ratio takes into account the average annual return of an ADR as well as, the volatility as measured by the standard deviation of the return. The standard deviation of the return is used as a proxy to indicate the risk in investing in the ADR. The Sharpe ratio measures the median return of an ADR in terms of how many standard deviation it is above or, below the risk-free rate. In other words, *the Sharpe ratio is used to determine how well the return of an ADR compensates the investor for the per unit risk that the investor takes.* A higher value of the Sharpe ratio for an ADR indicates a better financial performance (Rompotis, 2013).

Based on prior research findings, we have reason to believe that the Sharpe Ratios of pharmaceutical ADRs will differ from the Sharpe Ratios of U.S. pharmaceuticals. Also, they will differ from S&P 500. More formally, we hypothesize:

*H1. Ceteris Paribus, the Sharpe Ratios of pharmaceutical ADRs, U.S. Pharmaceutical companies, and S&P500 Index will differ.*

As to how to compare Sharpe ratios across ADRs and S&P 500 requires some discussions. In the past, several researchers developed hypothesis tests of Sharpe ratios using parametric methods that assumed normal distributions of financial returns (Johnson & Korkie, 1981; Memmel, 2003). Christie (2005) developed a model for an asymptotic distribution of Sharpe ratios. Parametric hypothesis tests usually assume normal distributions and iid (independent and identically distributed random variables) of financial returns (Sharifzadeh and Hojat, 2012, Nandy, 2014). Harwell (1988) demonstrated that using non parametric hypothesis tests would reduce the chances of Type I error, especially when sample sizes were small.

In this paper, we choose to use *Kruskal-Wallis* non parametric hypothesis test, thereby assuming that the Sharpe ratios of ADRs, stocks of US pharmaceutical companies and S&P 500 index are independent of each other. A 5% level of significance (risk of type I error) will be used to conduct the hypothesis test. The test statistic used for *Kruskal-Wallis* test is designated by H, where,

> $H= [12/n(n+1)][\sum(R_1)^2/n_1 + \sum(R_2)^2/n_{2+}\ldots.. +\sum(R_k)^2/n_k]-[3(n+1)]$ , with k-1 degrees of freedom


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k = number of populations (k=17 in this work.)

$\sum R_k$= sum of the ranks of ADRs, stocks of US pharmaceutical companies and S&P 500 index,

$n_k$= size of population k, and $n=n_1+n_2+\ldots+n_k = 277$

The distribution of the sample H statistic is very close to that of the chi-square distribution with k-1 degrees of freedom when every sample includes at least five observations. This situation is true on this analysis. The p-value of H is calculated using the chi-square distribution with k-1degrees of freedom.

## 4. RESULTS

We collected eleven pharmaceutical ADRs that are listed on NYSE. Most of the stocks we collected from 2000 to 2016. These ADRs are: Glaxo Smith Kline (ticker symbol: GSK, country of incorporation: UK) Astra Zeneca (ticker symbol: AZN, country: UK), Novaratis (ticker symbol: NVS, country: Switzerland), Novo Nordisk (ticker symbol: NVO, country: Denmark), Valeant Pharmaceuticals (ticker symbol: VRX, country: Canada), Taro Pharmaceuticals (ticker symbol: TARO, country: Israel) Teva Pharmaceuticals (ticker symbol: TEVA, country: Israel), Sanofi (ticker symbol: SNY, Country: France), Protalix Biotherapeutics (ticker symbol: PLX, country: Israel), Dr. Reddy's Lab (ticker symbol: RDY, country: India), and Aoxin Pharmaceutical (ticker symbol: AXN, country: China). Note that a few of the pharmaceutical ADRs have been listed in NYSE for a shorter period, such as AXN which has been listed since 2006, RDY since 2001, and SNY since 2003. We also collected the top five US pharmaceutical companies listed in NYSE for comparison: Johnson and Johnson (ticker symbol: JNJ), Pfizer (ticker symbol: PFE), Merck (ticker symbol: MRK), Eli Lilly (ticker symbol: LLY) and Bristol Myers Squib *ticker symbol: BMY). S&P 500 index for the corresponding years were also collected.

We then calculated the Sharpe ratios, based on the formula presented in the last section, of all the eleven pharmaceutical ADRs , the five U.S. pharmaceuticals, 91-day T-Bill, and S&P 500. The description statistics are presented in Table 2. As shown in Table 2, the mean annual returns of some of the ADRs are different from the mean annual returns of large US pharmaceutical companies. For example, the mean annual returns of VRX, PLX, TARO are higher than the mean annual returns of US pharmaceutical companies – JNJ, PFE, MRK, LLY and BMY. On the other hand, the mean annual returns of other ADRs, such as, GSK, AZN are lower than that of JNJ. The standard deviations of ADRs, US pharmaceutical companies and S&P 500 index are quite variable in nature. The mean annual returns of ADRs such as, GSK, AZN, NVO, NVS, TEVA are lower than the median annual returns of these same securities, This is also shown by the negative skew values in the distribution of the annual returns of these equities.

Table 3 depicts the median Sharpe ratios of eleven pharmaceutical ADRs, five equities of US pharmaceutical companies and S&P 500 index. The positive median


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Sharpe ratio values of ADRs - AZN, NVO, VRX, TEVA, TARO and US pharmaceutical security – MRK, and S&P 500 index indicate that the median returns of these equities are above that of the median returns of the relatively safe 91-day US Treasury bills.

Table 2: Descriptive Statistics of ADRs of Foreign Pharmaceutical Companies and Equities of Large US Pharmaceutical Companies Traded on NYSE

| Time Period | Security | Country | Mean Annual Return | Median Annual Return | Standard Deviation of Return | Skewness Median Return |
|---|---|---|---|---|---|---|
| 2000-2016 | 91-day T Bill | US | 0.061 | 0.021 | 0.169 | 1.447 |
| 2000-2016 | S&P 500 | US | 0.047 | 0.084 | 0.183 | -0.841 |
| 2000-2016 | GSK | UK | -0.009 | -0.004 | 0.129 | -0.056 |
| 2000-2016 | AZN | UK | 0.012 | -0.052 | 0.239 | -0.513 |
| 2004-2016 | SNY | France | 0.047 | -0.005 | 0.180 | 0.168 |
| 2000-2016 | NVS | Switzerland | 0.025 | 0.046 | 0.176 | -0.238 |
| 2000-2016 | NVO | Denmark | 0.087 | 0.123 | 0.426 | -0.511 |
| 2000-2016 | VRX | Canada | 0.128 | 0.086 | 0.571 | 0.773 |
| 2000-2016 | PLX | Israel | 0.870 | -0.400 | 4.651 | 3.549 |
| 2000-2016 | TEVA | Israel | 0.029 | 0.081 | 0.311 | -0.139 |
| 2002-2016 | TARO | Israel | 0.261 | 0.084 | 0.592 | 0.555 |
| 2002-2016 | RDY | India | 0.142 | 0.006 | 0.501 | 1.736 |
| 2007-2016 | AXN | China | 0.010 | -0.199 | 0.624 | 0.643 |
| 2000-2016 | JNJ | US | 0.025 | 0.082 | 0.138 | -1.444 |
| 2000-2016 | PFE | US | -0.030 | -0.024 | 0.190 | -0.176 |
| 2000-2016 | MRK | US | 0.014 | 0.045 | 0.227 | -0.475 |
| 2000-2016 | LLY | US | 0.022 | -0.012 | 0.167 | 0.289 |
| 2000-2016 | BMY | US | 0.009 | 0.031 | 0.221 | -0.355 |

Table 3: Comparison of the median Sharpe ratios of ADRs of Pharmaceutical Companies and Equities of Large US Pharmaceutical Companies and S&P 500 Index

| Time Period | Entity | Country | Median Sharpe Ratio |
|---|---|---|---|
| 2000-2016 | S&P 500 | US | 0.111 |
| 2000-2016 | GSK | UK | -0.600 |
| 2000-2016 | AZN | UK | 0.342 |
| 2004-2016 | SNY | France | -0.190 |
| 2000-2016 | NVS | Switzerland | -0.064 |
| 2000-2016 | NVO | Denmark | 0.175 |
| 2000-2016 | VRX | Canada | 0.055 |
| 2000-2016 | PLX | Israel | -0.086 |
| 2000-2016 | TEVA | Israel | 0.152 |


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| | | | |
|---|---|---|---|
| 2002-2016 | TARO | Israel | 0.196 |
| 2002-2016 | RDY | India | -0.113 |
| 2007-2016 | AXN | China | -0.440 |
| 2000-2016 | JNJ | US | -0.165 |
| 2000-2016 | PFE | US | -0.410 |
| 2000-2016 | MRK | US | 0.126 |
| 2000-2016 | LLY | US | -0.387 |
| 2000-2016 | BMY | US | -0.373 |

Table 4 reports the results of the non-parametric hypothesis testing of the median Sharpe ratios of S&P 500 index, eleven pharmaceutical ADRs and equities of five large US pharmaceutical companies. More formally, the results suggest that the null hypothesis that the distributions of Sharpe ratios of pharmaceutical ADRs, securities of US pharmaceutical companies, and of S&P 500 index have the same medians cannot be rejected at 5% level of significance.

Table 4: Comparison of Decisions about Null Hypotheses regarding median Sharpe of S&P 500 index, ADRs and Stocks of Large US Pharmaceutical Companies Traded on NYSE

| **Time Period** | **Entity** | **Country** | **Decision about $H_0$ (Same medians for ADRs, US Pharmaceutical Companies and S&P 500 Index) for Sharpe Ratios** |
|---|---|---|---|
| 2000-2016 | S&P 500 | US | Do not reject |
| 2000-2016 | GSK | UK | Do not reject |
| 2000-2016 | AZN | UK | Do not reject |
| 2004-2016 | SNY | France | Do not reject |
| 2000-2016 | NVS | Switzerland | Do not reject |
| 2000-2016 | NVO | Denmark | Do not reject |
| 2000-2016 | VRX | Canada | Do not reject |
| 2000-2016 | PLX | Israel | Do not reject |
| 2000-2016 | TEVA | Israel | Do not reject |
| 2000-2016 | TARO | Israel | Do not reject |
| 2002-2016 | RDY | India | Do not reject |
| 2007-2016 | AXN | China | Do not reject |
| 2007-2016 | JNJ | US | Do not reject |


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| | | | |
|---|---|---|---|
| 2000-2016 | PFE | US | Do not reject |
| 2000-2016 | MRK | US | Do not reject |
| 2000-2016 | LLY | US | Do not reject |
| 2000-2016 | BMY | US | Do not reject |

## 5. DISCUSSION

The non-parametric comparisons of the Sharpe Ratios of pharmaceutical ADRs, U.S. equities of major pharmaceuticals, and S&P 500 Index revealed that there are no difference in returns among these three group of investments. While our results are different from those obtained from prior research that continuously found ADRs perform differently than S&P500 Index or NASDAQ, our results shed new light on how after discounting a risk-free factor (i.e., 91-day treasury bill) that the returns on various groups of investments may differ little. Another explanation of our results could be due to the longer-term of 17 years performance that we measured. It is also possible that the risk of investing in ADRs or U.S. companies in the pharmaceutical industry is similar as these companies are perceived as equally global.

Previous research used means, not median, in their calculation of returns of ADRs. As shown in Table 2, mean annual returns are not the same as median annual return and may behave in opposition directions (e.g., PLX mean is .87 but median is 0.40 subject to Standard deviation of return). If we were to only consider mean annual return as presented in the fourth column in Table 2, we may conclude erroneously that ten out of eleven ADRs have positive returns, and four out of five U.S. pharmaceuticals have positive returns. In fact, from medium annual return presented in the fifth column in the same Table reported six (five) ADRs having positive (negative) returns, and three (two) U.S. pharmaceutical firms have positive (negative) returns.

Another difference is prior research did not calculate Sharpe ratios to compare the returns of ADRs to the returns from a safe investment, such as, 91-day US Treasury bill. The results from the current work show that the median annual Sharpe ratios of only five ADRs - AZN (UK), NVO (Denmark), VRX (Canada), TEVA (Israel), TARO (Israel) are positive – indicating higher returns than that of the safe 91-day US Treasury bill. The median Sharpe ratios of the remaining six ADRs in this study are negative – indicating lower returns than that of the safe 91-day US Treasury bill. Again our study spans 17 years of returns of most cases while previous research were mainly capturing 21-day or 3 year returns.

Interestingly for U.S. companies, only MRK has positive Median Sharpe ratio. This result may echo what Nathan (2012) predicted that European pharmaceutical companies could dominate global market with only one of the top five U.S. pharmaceuticals would remain competitive. ADRs fair better with 5 out of 11 having positive Median Sharpe ratio. Israeli pharmaceutical companies fair better with two out of three in the positive range.


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## 6. CONCLUSIONS

In this research, the financial returns of ADRs of all foreign pharmaceutical companies listed in NYSE, equities of US pharmaceutical companies and S&P 500 index are compared for a period of seventeen years, from 2000 through 2016. A non-parametric hypothesis has been conducted to compare their Sharpe ratios. The result of this hypothesis test indicates that the null hypothesis that the distributions of Sharpe ratios have the same medians is not rejected. There are some limitations of this study as we attempted to investigate a longer timeframe of 17 years rather than the average 3-year timeframe in previous research. Future research should consider a range of timeframe such as 5-year, 10-year, and 15-year to add more nuanced time dimension to the performance of ADRs. We introduced a risk-free perspective by using Sharpe ratios in this article for pharmaceutical industry only ADRs, future research should consider applying Sharpe ratios for another industry. We have followed most of the previous research and used S&P 500 Index for comparisons, future research should consider using Sharpe Ratios and compare ADRs against NASDAQ Index.

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